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Mineralogical and Geochemical Characterization of the Hop Waste-Rock Dump (Roşia Montană Gold Mine, Romania)

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Roşia Montană, the largest gold mine in Europe, was closed in 2006 after a long mining history, dating back to Roman times. Waters draining the mine site are characterized by low pH and high concentration of potential toxic elements (PTE), leading to severe pollution of the Roşia and Abrud Rivers (BIRD et al., 2005). The waste-rock piles stored during exploitation can be among the main sources of PTEs release and water acidification as a consequence of active and intense Acid Mine Drainage (AMD) processes. With this study we have characterized the mineralogical and chemical composition of the Hop dump, one of the main waste-rock dumps of the Roşia Montană gold mine. Twenty-five samples were collected on the eastern part of the Hop dump, following a virtual squared grid (knots distance of 25-30m). Geochemical and mineralogical features of each sample were investigated by means of SEM-EDS, XRPD, XRF and ICP-AES analyses. Moreover, the chemical reactivity was tested by means of static tests, following AMIRA procedure (IWRI and EGI, 2002), and kinetic tests following the “modified EPA method 1312” (SPLP– EPA, 1994). Lithology and mineralogy of the waste material are heterogeneous, with the main lithotypes being: metasomatized porphyritic dacites, andesites, flyschoid rocks and polygenic breccias. Nevertheless, on the basis of the main lithotype and matching field and analytical data with Positive Matrix Factorisation processing, the waste-rock samples have been divided into two main groups: one labelled as “andesitic breccia"; the other labelled as “dacite”. A third independent factor was identified and related to the occurrence of “residual ore” in the waste-rocks. The concentrations of PTEs in the waste rocks are below the regulatory limits, with the exception of As, which has concentrations up to 10 times higher than the threshold prescribed by international law. The SEM analyses showed that a part of the As content is associated to primary minerals occurring within the dacite-rich samples (particularly arsenopyrite and As-bearing pyrite) and the remaining part is mainly present in the secondary authigenic iron oxyhydroxides (mainly goethite) and oxyhydroxysulphates (mainly schwertmannite and jarosite). The results of static tests and mineralogy indicate that only the dacite-rich samples are expected to generate AMD, since the andesite-rich ones have an acid-neutralizing capacity (ANC) higher than the maximum potential acidity (MPA) due to high concentrations of carbonate minerals (mainly calcite and dolomite). Kinetic tests showed that PTE contents in filtered solutions are generally low and under the law threshold. The pH value of leachates greatly varies, from 2.9 to 8.9, and their sulphate content ranges between 13.5 and 475 ppm. The comparison between the geochemical features of the leached waters and the bulk chemistry of waste-rocks shows that the release of As and other PTEs in aqueous solutions is very poor, despite their hazardous concentrations in the solid material. These results suggest that most of the PTEs released during the AMD processes are efficiently uptaken by the new forming iron oxyhydroxides and oxyhydroxysulphates.

References

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